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AQUATIC INVERTEBRATES AND HABITAT AT THREE SITES ON THE SOUTH FORK JUDITH RIVER: A BIOASSESSMENT

August 30, 2001

By
W. Bollman
Rhithron Associates, Inc.

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A report to

**The Montana Department of Environmental Quality
Helena, Montana**

by

**W. Bollman
Rhithron Associates, Inc.
Missoula, Montana**

September 2002

INTRODUCTION

Aquatic invertebrates are aptly applied to bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Long lives, complex life cycles and limited mobility mean that there is ample time for the benthic community to respond to cumulative effects of environmental perturbations.

This report summarizes data collected from 3 sites on the South Fork Judith River in the Lewis and Clark National Forest, Judith Basin County, Montana. Aquatic invertebrate assemblages were sampled by U.S. Forest Service (USFS) personnel. Study sites lie within the Northern Rockies Ecoregion (Woods et al. 1999). A multimetric approach to bioassessment such as the one applied in this study uses attributes of the assemblage in an integrated way to measure biotic health. A stream with good biotic health is "...a balanced, integrated, adaptive system having the full range of elements and processes that are expected in the region's natural environment..." (Karr and Chu 1999). The approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as "... an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition" (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment (Fore et al. 1994). Effectiveness of the integrated metrics depends on the applicability of the underlying model, which rests on a foundation of three essential elements (Bollman 1998). The first of these is an appropriate stratification or classification of stream sites, typically, by ecoregion. Second, metrics must be selected based upon their ability to accurately express biological condition. Third, an adequate assessment of habitat conditions at each site to be studied is needed to assist in the interpretation of metric outcomes.

Implicit in the multimetric method and its associated habitat assessment is an assumption of correlative relationships between habitat parameters and the biotic metrics in the absence of water quality impairment. These relationships may vary regionally, requiring an examination of habitat assessment elements and biotic metrics and a test of the presumed relationship between them. Bollman (1998) has recently studied the assemblages of the Montana Valleys and Foothill Prairies ecoregion and has recommended a battery of metrics applicable to the montane ecoregions of Western Montana. This metric battery has been shown to be sensitive to impairment, related to habitat assessment parameters, and consistent over replicated samples.

Habitat assessment enhances the interpretation of biological data (Barbour and Stribling 1991), because there is generally a direct response of the biological community to habitat degradation in the absence of water quality impairment. If biotic health appears more damaged than the habitat quality would predict, water pollution by metals, other toxicants, high water temperatures, or high levels of organic and/or nutrient pollution might be suspected. On the other hand, an "artificial" elevation of biotic condition in the presence of habitat degradation may be due to the paradoxical effect of mild nutrient or organic enrichment in an oligotrophic setting.

METHODS

Aquatic invertebrates were sampled by U.S. Forest Service personnel on August 30, 2001. Site locations, descriptions, and sampling dates are indicated in Table 1. The sampling method employed was that recommended in the Montana Department of Environmental Quality (DEQ) Standard Operating Procedures for Aquatic Macroinvertebrate Sampling (Bukantis 1998). In addition to aquatic invertebrate sample collection, habitat quality was visually evaluated at each site and reported by means of the habitat assessment protocols recommended by Bukantis (1998) for streams with riffle/run prevalence.

Aquatic invertebrate samples were delivered to Rhithron Associates, Inc., Missoula, Montana, for laboratory and data analyses. In the laboratory, the Montana DEQ-recommended sorting method was used to obtain subsamples of at least 300 organisms from each sample, when possible. Organisms were identified to the lowest possible taxonomic levels consistent with Montana DEQ protocols.

To assess aquatic invertebrate communities in this study, a multimetric index developed in previous work for streams of Western Montana ecoregions (Bollman 1998) was used. Multimetric indices result in a single numeric score, which integrates the values of several individual indicators of biologic health. Each metric used in this index was tested for its response or sensitivity to varying degrees of human influence. Correlations have been demonstrated between the metrics and various symptoms of human-caused impairment manifested in water quality parameters or instream, streambank, and stream reach morphologic features. Metrics were screened to minimize variability over natural environmental gradients, such as site elevation or sampling season, which might confound interpretation of results (Bollman 1998). The multimetric index used in this report incorporates multiple attributes of the sampled assemblage into an integrated score that accurately describes the benthic community of each site in terms of its biologic integrity. In addition to the metrics comprising the index, other metrics, which have been shown to be applicable to biomonitoring in other regions (Kleindl 1995, Patterson 1996, Rossano 1995) were used for descriptive interpretation of results. These metrics include the number of "clinger" taxa, long-lived taxa richness, the percent of predatory organisms, and others. They are not included in the integrated bioassessment score, however, since their performance in Western Montana ecoregions is unknown. However, the relationship of these metrics to habitat conditions is intuitive and reasonable.

Table 1. Sampling sites and dates. South Fork Judith River, August 30, 2000.

Site Number	MT DEQ Station ID	Location description	GPS location	USFS Site designation
1	M22JRSFK01	Below confluence of Russian Creek, ~1.5 mile below Hidden Lake	46°46'39.9"N 110°18'3.7"W	Site #3
2	M22JRSFK02	~1 mile above old USGS guage; area where stream is near the road	46°44'48"N 110°20'13.7"W	Site #2
3	M22JRSFK03	Below confluence of Dry Pole Canyon near campground	46°43'15.3"N110°25'28.1"W	Site #1

The six metrics comprising the bioassessment index used in this study were selected because, both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998). In addition, they are relevant to the kinds of impacts that are present in the South Fork Judith River watershed. They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998). Each of the six metrics developed and tested for western Montana ecoregions is described below.

1. Ephemeroptera (mayfly) taxa richness. The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific conductance, and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.

2. Plecoptera (stonefly) taxa richness. Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development, and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.

3. Trichoptera (caddisfly) taxa richness. Caddisfly taxa richness has been shown to decline when sediment deposition affects their habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.

4. Number of sensitive taxa. Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability, and other impacts. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998).

5. Percent filter feeders. Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* spp. and *Parapsyche* sp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.

6. Percent tolerant taxa. Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability, and others.

Scoring criteria for each of the six metrics are presented in Table 2. Metrics differ in their possible value ranges as well as in the direction the values move as biological conditions change. For example, Ephemeroptera richness values may range from zero to ten taxa or higher. Larger values generally indicate favorable biotic conditions. On the other hand, the percent filterers metric may range from 0% to 100%; in this case, larger values are negative indicators of biotic health. To facilitate scoring, therefore, metric values were transformed into a single scale. The range of each metric has been divided into four parts and assigned a point score between zero and three. A score of three indicates a metric value similar to one characteristic of a non-impaired condition. A score of zero indicates strong deviation from non-impaired condition and suggests severe degradation of biotic health. Scores for each metric were summed to give an overall score, the total bioassessment score, for each site in each sampling event. These scores were expressed as the percent of the maximum possible score, which is 18 for this metric battery.

The total bioassessment score for each site was expressed in terms of use-support. Criteria for use-support designations were developed by Montana DEQ and are presented in Table 3a. Scores were also translated into impairment classifications according to criteria outlined in Table 3b.

Table 2. Metrics and scoring criteria for bioassessment of streams of western Montana ecoregions (Bollman 1998).

	Score			
metric	**3**	**2**	**1**	**0**
Ephemeroptera taxa richness	> 5	5 - 4	3 – 2	< 2
Plecoptera taxa richness	> 3	3 - 2	1	0
Trichoptera taxa richness	> 4	4 - 3	2	< 2
Sensitive taxa richness	> 3	3 - 2	1	0
Percent filterers	0 – 5	5.01 - 10	10.01 – 25	> 25
Percent tolerant taxa	0 – 5	5.01 - 10	10.01 – 35	> 35

Table 3a. Criteria for the assignment of use-support classifications / standards violation thresholds (Bukantis 1998).

% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated

Table 3b. Criteria for the assignment of impairment classifications (Plafkin et al. 1989).

% Comparability to reference	Classification
> 83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

In this report, certain other metrics were used as descriptors of the benthic community response to habitat or water quality but were not incorporated into the bioassessment metric battery because: they have not yet been tested for reliability in streams of western Montana; results of such testing did not show them to be robust at distinguishing impairment; or they did not meet other requirements for inclusion in the metric battery. These metrics and their use in predicting the causes of impairment or in describing its effects on the biotic community are described below.

- The modified biotic index. This metric is an adaptation of the Hilsenhoff Biotic Index (HBI, Hilsenhoff 1987), which was originally designed to indicate organic enrichment of waters. Values of this metric are lowest in least impacted conditions. Taxa tolerant to saprobic conditions are also generally tolerant of warm water, fine sediment, and heavy filamentous algae growth (Bollman 1998a). Loss of canopy cover is often a contributor to higher biotic index values. The taxa values used in this report are modified to reflect habitat and water quality conditions in Montana (Bukantis 1998). Ordination studies of the benthic fauna of Montana's foothill prairie streams showed that there is a correlation between modified biotic index values and water temperature, substrate embeddedness, and fine sediment (Bollman 1998). In a study of reference streams, the average value of the modified biotic index in least-impaired streams of western Montana was 2.5 (Wisseman 1992).
- Taxa richness. This metric is a simple count of the number of unique taxa present in a sample. Average taxa richness in samples from reference streams in western Montana was 28 (Wisseman 1992). Taxa richness is an expression of biodiversity and generally decreases with degraded habitat or diminished water quality. However, taxa richness may show a paradoxical increase when mild nutrient enrichment occurs in previously oligotrophic waters, so this metric must be interpreted with caution.
- Percent predators. Aquatic invertebrate predators depend on a reliable source of invertebrate prey, and their abundance provides a measure of the trophic complexity supported by a site. Less disturbed sites have more plentiful habitat niches to support diverse prey species, which in turn support abundant predator species.
- Number of "clinger" taxa. So-called "clinger" taxa have physical adaptations that allow them to cling to smooth substrates in rapidly flowing water. Aquatic invertebrate "clingers" are sensitive to fine sediments that fill interstices between substrate particles and eliminate habitat complexity. Animals that occupy the hyporheic zones are included in this group of taxa. Expected "clinger" taxa richness in unimpaired streams of western Montana is at least 14 (Bollman 1998a).
- Number of long-lived taxa. Long-lived or semivoltine taxa require more than a year to completely develop, and their numbers decline when habitat and/or water quality conditions are unstable. They may completely disappear if channels are dewatered or if there are periodic water temperature elevations or other interruptions to their life cycles. Western Montana streams with stable habitat conditions are expected to support six or more long-lived taxa (Bollman 1998a).

RESULTS

Habitat assessment

Figure 1 compares habitat assessment results for the 3 sites visited. Table 4 itemizes the evaluated habitat parameters and shows the assigned scores for each.

Figure 1. Total habitat assessment scores for the South Fork Judith River, August 30, 2001. Sites are listed in upstream-to-downstream order.

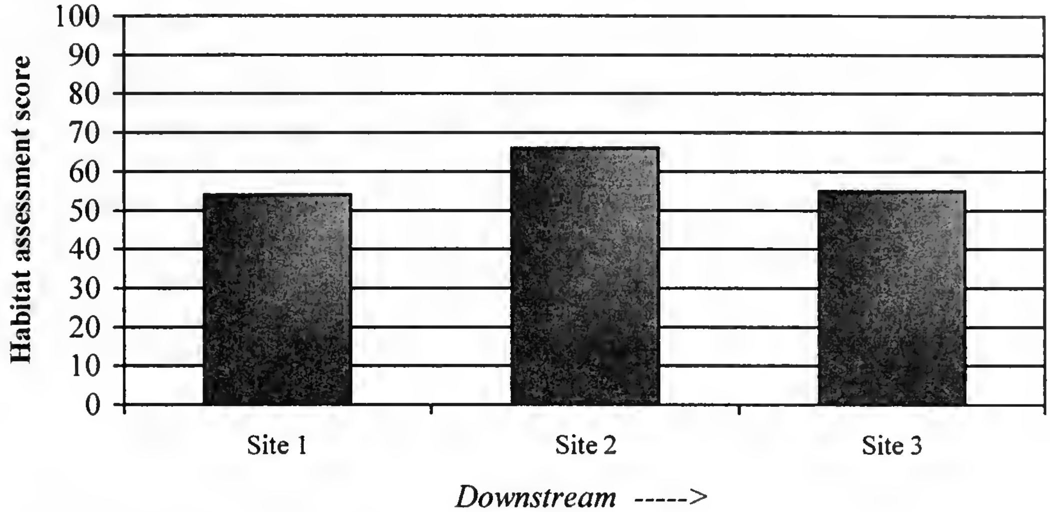


Table 4. Stream and riparian habitat assessment. South Fork Judith River, August 30, 2001. Sites are listed in upstream-to-downstream order.

Maximum possible score	Parameter	Site 1	Site 2	Site 3
10	Riffle development	8	9	8
10	Benthic substrate	7	9	9
20	Embeddedness	5	10	8
20	Channel alteration	14	11	6
20	Sediment deposition	6	13	8
20	Channel flow status	10	14	15
20	Bank stability r / l	6 / 6	6 / 9	2 / 8
20	Bank vegetation r / l	7 / 7	7 / 7	5 / 8
20	Vegetated zone r / l	4 / 7	6 / 4	1 / 10
160	Total	87	105	88
	Percent of maximum	**54**	**66**	**55**
	CONDITION*	**MARG**	**SUB**	**MARG**

*Condition categories: Optimal (OPT) > 80% of maximum score; Sub-optimal (SUB) 75 - 56%; Marginal (MARG) 49 - 29%; Poor <23%. Adapted from Plafkin et al. 1988.

Overall habitat conditions at the uppermost site (Site 1) scored marginally. Benthic substrate was perceived to be somewhat more monotonous than expected. Substrate particles were deeply embedded; moderate deposition of sediment was noted. Streambanks were judged moderately stable, with some disruption of the vegetative protection evident. The riparian zone width was abbreviated on both sides of the channel. Flow conditions were perceived to be marginal. At the middle site (Site 2), overall habitat conditions scored sub-optimally. While substrate composition was varied, moderate embeddedness was noted. Some sediment deposition was also assessed. Streambanks were perceived to be stable on the right side and moderately stable on the left side, with some disruption of vegetation noted. The riparian zone width was confined on the right side by the valley wall; on the left side, an abbreviated riparian zone merged with a grassy meadow. Flow conditions at this site were judged sub-optimal. Habitat conditions scored marginally at the downstream site (Site 3). Benthic substrate had optimal diversity, but particles were moderately embedded, and moderate deposition of sediment was reported. Natural channel morphology was altered by an adjacent road. Streambanks were moderately stable on the right side, but unstable on the left side, where the road was located. Disruption of streambank vegetation was particularly evident on the left side of the channel. The riparian zone was nearly non-existent on the left side, but optimal width was noted on the right side. Flow conditions were judged sub-optimal.

Bioassessment metrics

Figure 2 summarizes bioassessment scores for aquatic invertebrate communities at the 3 sites on the South Fork Judith River. Table 5 itemizes each contributing metric and shows individual metric scores for each site. Tables 3a and 3b show criteria for impairment classifications and use-support categories recommended by Montana DEQ.

Figure 2. Total bioassessment scores, expressed as percent of maximum, for 3 sites on the South Fork Judith River, August 30, 2001. The revised bioassessment method (Bollman 1998) was used.

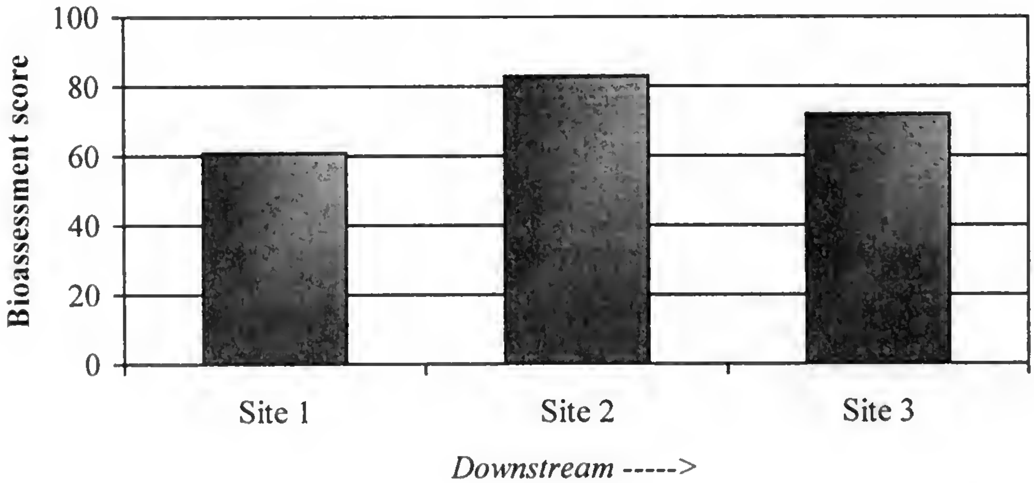


Table 5. Metric values and bioassessments for 3 sites on the South Fork Judith River, August 30, 2001.

	Sites		
	Site 1	Site 2	Site 3
Metrics			
Ephemeroptera richness	5	9	10
Plecoptera richness	3	4	4
Trichoptera richness	2	7	7
Sensitive taxa richness	5	5	1
Percent tolerant taxa	10.5	11.5	28.9
Percent filter-feeders	9.2	5.9	3
		Metric scores	
Ephemeroptera richness	2	3	3
Plecoptera richness	2	3	3
Trichoptera richness	1	3	3
Sensitive taxa richness	3	3	1
Percent tolerant taxa	1	1	0
Percent filter-feeders	2	2	3
Total score (maximum = 18)	11	15	13
Percent of maximum	**61**	**83**	**72**
Use support*	**PARTIAL**	**FULL**	**PARTIAL**
Impairment classification[1]	**SLIGHT**	**NON**	**SLIGHT**

1. Classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3b.

*Use support designations: See Table 3a.

When this bioassessment method is applied to the aquatic invertebrate data generated in this study, scores indicate partial support of designated uses, and slight impairment of biotic health at the upper (Site 1) and lower (Site 3) sites, and fully supported uses and no impairment at the middle site.

Aquatic invertebrate communities

At the upper site (Site 1), community tolerance as measured by the biotic index value (3.83) was slightly higher than expected for an unimpaired montane stream. In addition, the mayfly taxa richness (5) was somewhat lower than anticipated. These findings suggest that mild nutrient enrichment may impair water quality at this site. Other features of the benthic assemblage imply that deposition of fine sediments may be a nutrient source.

Both caddisfly taxa richness and the number of "clinger" taxa were low at this site, suggesting that fine sediment deposition limits instream habitats. Taxonomically, the composition of the sampled assemblage was skewed toward chironomids, suggesting that

fine sediment habitats were plentiful at the site. Among the midges collected, 2 hemoglobin-bearing taxa were present; together they represented almost 10% of organisms in the sample. The abundance of these animals may indicate that sediments were hypoxic or even anoxic.

Functionally, the assemblage was skewed toward gatherers; scrapers were limited to the mayfly *Ameletus* sp.; only 2 individuals of this taxon were collected. The limited number of scrapers may have been due to the lack of clean substrate uncompromised by fine sediment deposition. Shredders were also underrepresented; suggesting that riparian inputs of large organic material was limited, or that flow conditions did not favor the retention of such material. Only 2 taxa of long-lived animals were collected, but there were 38 individuals of *Heterlimnius* sp., a long-lived beetle, suggesting that dewatering or other catastrophes have not recently interrupted life cycles.

At the middle site (Site 2), the low biotic index (2.49) and diverse mayfly fauna (9 taxa) suggest that water quality at this site was good, perhaps influenced by tributaries. No fewer than 36 taxa were present at the site, implying that instream habitats were diverse and unspoiled. Fifteen "clinger" taxa and 7 caddisfly taxa were taken in the sample; although caddisflies were not abundant, 49% of organisms in the sample belonged to one of these groups. These findings indicate that hard benthic substrates unimpaired by fine sediment deposition were available for colonization.

All expected functional components of a cold, clean montane stream essentially unimpaired by habitat degradation were present in appropriate balance at the site. Shredders comprised 11% of animals in the sample, suggesting adequate riparian inputs and flow conditions favorable for retention of large organic debris.

At the lower site (Site 3), the biotic index (3.56) was slightly higher than expected for a montane stream, but mayfly taxa richness was high. Equivocal results from these water quality indicators may be due to water temperatures elevated slightly above expectations. The abundance of water mites, and the presence of the snails *Fossaria* sp. and *Physella* sp. add strength to this hypothesis. These 3 non-insect taxa made up 30% of collected animals. Other taxa present at the site suggest warmer water; among these are the mayflies *Paraleptophlebia bicornuta* and *Procloeon* sp. and the elmid *Optioservus* sp. Only a single cold stenotherm was present in the sample. Low flow conditions may exacerbate warming.

A rich caddisfly fauna (7 taxa) and 15 "clinger" taxa imply that fine sediment deposition did not limit colonization of hard benthic substrates. Thirty-eight taxa were supported at the site, implying diverse and abundant instream habitats of all types.

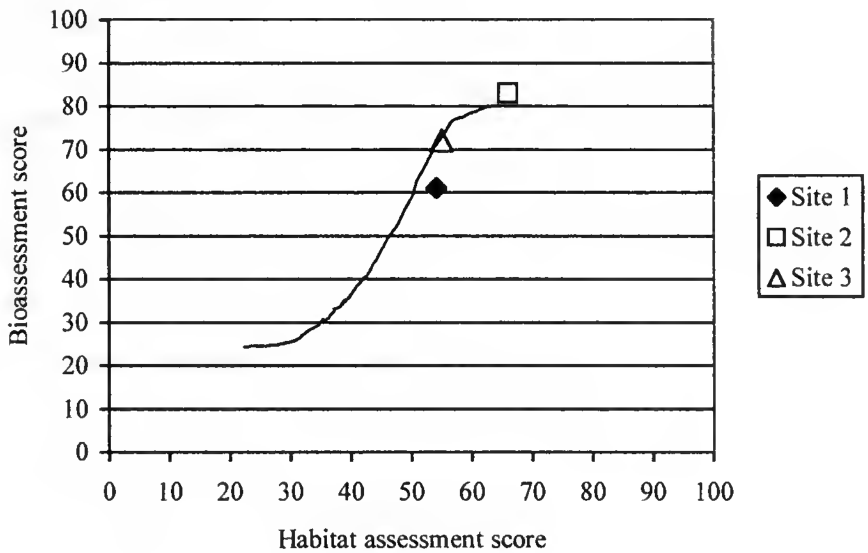
The functional composition of the sampled assemblage was skewed toward parasites, which is suggestive of water temperatures warmer than expected for a montane stream. Scrapers were abundant, and some shredders were present in the sample. Long-lived taxa comprised 25% of the collected animals, implying that catastrophic interruptions of life cycles were not a limiting factor to biotic health at this site.

CONCLUSIONS

- Fine sediment deposition and accompanying nutrient inputs appeared to affect the benthic assemblage at the upstream site (Site 1).
- Site 2 supported a diverse assemblage characteristic of a cold mountain stream with clean water and unimpaired habitat.

- At the lower site (Site 3), warm water temperatures may influence the invertebrate community.
- The relationship between habitat assessment scores and bioassessment scores is illustrated in Figure 3. The position of the symbols representing the sampling sites suggests that Sites 1 and 3 are limited mainly by habitat degradation, whereas Site 2 falls in the portion of the graph suggesting unimpaired habitat and water quality.

Figure 3. Total bioassessment scores plotted against habitat assessment scores for 3 sites on the South Fork Judith River, August 30, 2001. The red line describes the hypothetical relationship expected when water quality is good and biotic health is determined predominantly by habitat quality (Barbour and Stribling 1991).



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APPENDIX

Taxonomic data and summaries

South Fork Judith River

August 30, 2001

Aquatic Invertebrate Taxonomic Data

Site Name: South Fork Judith River **Date: 8/30/01**

Site ID: Site 1: below confluence of Russian Creek Approx. percent of sample used: 7

Taxon	Quantity	Percent	HBI	FFG
Acari	1	0.33	5	PA
Total Misc. Taxa	**1**	**0.33**		
Baetis tricaudatus	2	0.66	4	CG
Drunella doddsi	1	0.33	1	CG
Drunella grandis	4	1.32	2	CG
Ephemerella inermis	78	25.66	4	CG
Ameletus sp.	3	0.99	0	SC
Total Ephemeroptera	**88**	**28.95**		
Sweltsa sp.	1	0.33	0	PR
Despaxia augusta	2	0.66	0	SH
Zapada cinctipes	5	1.64	3	SH
Total Plecoptera	**8**	**2.63**		
Micrasema sp.	1	0.33	1	SH
Rhyacophila narvae	2	0.66	0	PR
Total Trichoptera	**3**	**0.99**		
Oreodytes sp.	1	0.33	5	PR
Heterlimnius sp.	36	11.84	3	CG
Total Coleoptera	**37**	**12.17**		
Glutops sp.	1	0.33	1	PR
Pericoma sp.	21	6.91	4	CG
Total Diptera	**22**	**7.24**		
Cryptochironomus sp.	1	0.33	8	PR
Heterotrissocladius sp.	28	9.21	0	CG
Macropelopia sp.	7	2.30	6	PR
Orthocladius sp.	33	10.86	6	CG
Pagastia sp.	3	0.99	1	CG
Polypedilum sp.	2	0.66	6	SH
Stempellina sp.	10	3.29	2	CG
Stictochironomus sp.	28	9.21	5	CG
Tanytarsus sp.	28	9.21	6	CF
Tvetenia sp.	5	1.64	5	CG
Total Chironomidae	**145**	**47.70**		
Grand Total	**304**	**100.00**		

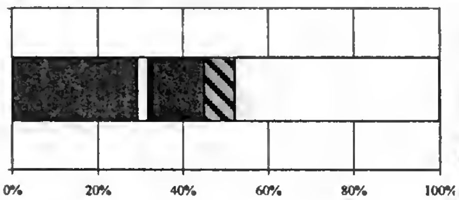
Aquatic Invertebrate Summary

Site Name: South Fork Judith River **Date: 8/30/01**

SAMPLE TOTAL	304
EPT abundance	99
TAXA RICHNESS	25
Number EPT taxa	10
Percent EPT	32.57

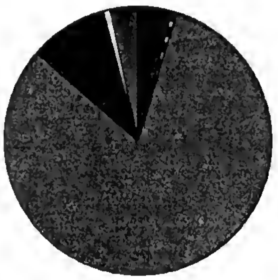
TAXONOMIC COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Misc. Taxa	0.33	1	1
Odonata	0.00	0	0
Ephemeroptera	28.95	5	88
Plecoptera	2.63	3	8
Hemiptera	0.00	0	0
Megaloptera	0.00	0	0
Trichoptera	0.99	2	3
Lepidoptera	0.00	0	0
Coleoptera	12.17	2	37
Diptera	7.24	2	22
Chironomidae	47.70	10	145



FUNCTIONAL COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Predator	4.28	6	13
Parasite	0.33	1	1
Gatherer	81.91	12	249
Filterer	9.21	1	28
Herbivore	0.00	0	0
Piercer	0.00	0	0
Scraper	0.99	1	3
Shredder	3.29	4	10
Xylophage	0.00	0	0
Omnivore	0.00	0	0
Unknown	0.00	0	0



COMMUNITY TOLERANCES

Sediment tolerant taxa	0
Percent sediment tolerant	0.00
Sediment sensitive taxa	0
Percent sediment sensitive	0.00
Metals tolerance index (McGuire)	3.53
Cold stenotherm taxa	3
Percent cold stenotherms	1.32

Site ID: Site 1: below confluence of Russian Creek

DOMINANCE

TAXON	ABUNDANCE	PERCENT
Ephemerella inermis	78	25.66
Heterlimnius sp.	36	11.84
Orthocladius sp.	33	10.86
Heterotrissocladius sp.	28	9.21
Stictochironomus sp.	28	9.21
SUBTOTAL 5 DOMINANTS	203	66.78
Tanytarsus sp.	28	9.21
Pericoma sp.	21	6.91
Stempellina sp.	10	3.29
Macropelopia sp.	7	2.30
Zapada cinctipes	5	1.64
TOTAL DOMINANTS	274	90.13

SAPROBITY

Hilsenhoff Biotic Index	3.83

DIVERSITY

Shannon H (loge)	2.07
Shannon H (log2)	2.99
Simpson D	0.11

VOLTINISM

TYPE	ABUNDANCE	PERCENT
Multivoltine	111	36.60
Univoltine	155	50.90
Semivoltine	38	12.50

TAXA CHARACTERS

	#TAXA	ABUNDANCE	PERCENT
Tolerant	4	32	10.53
Intolerant	5	42	13.82
Clinger	8	152	50.00

BIOASSESSMENT INDICES

B-IBI (Karr et al.)

METRIC	VALUE	SCORE	
Taxa richness	25	3	
E richness	5	3	
P richness	3	1	
T richness	2	1	
Long-lived	2	1	
Sensitive richness	5	5	
%tolerant	10.53	5	
%predators	4.28	1	
Clinger richness	8	1	
%dominance (3)	48.36	5	
TOTAL SCORE		26	52 %

MONTANA DEQ METRICS (Bukantis 1998)

METRIC	VALUE	Plains Ecoregions	Valleys and Foothills	Mountain Ecoregions
Taxa richness	25	3	2	2
EPT richness	10	3	0	0
Biotic Index	3.83	3	3	2
%Dominant taxon	25.66	3	3	2
%Collectors	91.12	1	0	0
%EPT	32.57	2	1	0
Shannon Diversity	2.99	2		
%Scrapers +Shredd	4.28	1	0	0
Predator taxa	6	3		
%Multivoltine	36.60	3		
%H of T	0		3	
TOTAL SCORES		24	12	6
PERCENT OF MAXIMUM		80.00	50.00	28.57
IMPAIRMENT CLASS		SLIGHT	MODERATE	MODERATE

Aquatic Invertebrate Taxonomic Data

Site Name: South Fork Judith River **Date: 8/30/01**
Site ID: Site 2: above old USGS guage Approx. percent of sample used: 7

Taxon	Quantity	Percent	HBI	FFG
Sphaeriidae	4	1.31	8	CF
Fossaria sp.	1	0.33	6	SC
Ostracoda	14	4.59	8	CG
Acari	11	3.61	5	PA
Total Misc. Taxa	**30**	**9.84**		
Baetis tricaudatus	33	10.82	4	CG
Diphetor hageni	1	0.33	5	CG
Drunella doddsi	1	0.33	1	CG
Drunella grandis	2	0.66	2	CG
Ephemerella sp.	32	10.49	1	CG
Cinygmula sp.	49	16.07	0	SC
Rhithrogena sp.	46	15.08	0	CG
Paraleptophlebia sp.	3	0.98	1	CG
Ameletus sp.	2	0.66	0	SC
Total Ephemeroptera	**169**	**55.41**		
Sweltsa sp.	1	0.33	0	PR
Despaxia augusta	5	1.64	0	SH
Zapada cinctipes	27	8.85	3	SH
Hesperoperla pacifica	1	0.33	2	PR
Total Plecoptera	**34**	**11.15**		
Arctopsyche grandis	1	0.33	2	PR
Brachycentrus americanus	2	0.66	1	CF
Micrasema sp.	2	0.66	1	SH
Glossosoma sp.	2	0.66	0	SC
Apatania sp.	1	0.33	3	SC
Rhyacophila Brunnea Gr.	2	0.66	2	PR
Rhyacophila narvae	1	0.33	0	PR
Total Trichoptera	**11**	**3.61**		
Heterlimnius sp.	6	1.97	3	CG
Total Coleoptera	**6**	**1.97**		
Glutops sp.	1	0.33	1	PR
Pericoma sp.	10	3.28	4	CG
Antocha sp.	2	0.66	3	CG
Total Diptera	**13**	**4.26**		
Orthocladius sp.	14	4.59	6	CG
Pagastia sp.	1	0.33	1	CG
Rheotanytarsus sp.	11	3.61	6	CF
Stempellina sp.	5	1.64	2	CG
Stictochironomus sp.	1	0.33	5	CG
Tanytarsus sp.	1	0.33	6	CF
Thienemannimyia Gr.	5	1.64	5	PR
Tvetenia sp.	4	1.31	5	CG
Total Chironomidae	**42**	**13.77**		
Grand Total	**305**	**100.00**		

Aquatic Invertebrate Summary

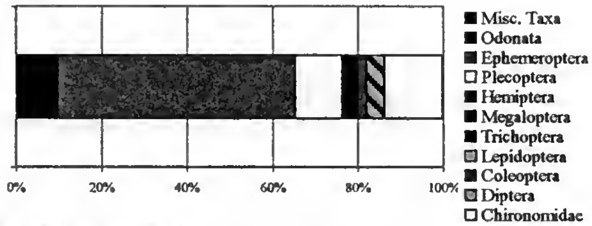
Site Name: South Fork Judith River **Date: 8/30/01**

Site ID: Site 2: above old USGS guage

SAMPLE TOTAL	305
EPT abundance	214
TAXA RICHNESS	36
Number EPT taxa	20
Percent EPT	70.16

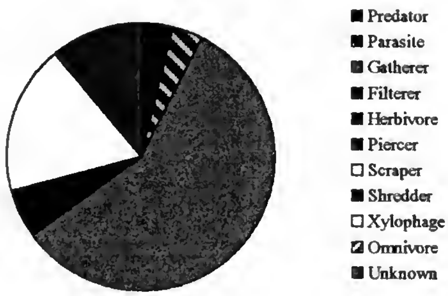
TAXONOMIC COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Misc. Taxa	9.84	4	30
Odonata	0.00	0	0
Ephemeroptera	55.41	9	169
Plecoptera	11.15	4	34
Hemiptera	0.00	0	0
Megaloptera	0.00	0	0
Trichoptera	3.61	7	11
Lepidoptera	0.00	0	0
Coleoptera	1.97	1	6
Diptera	4.26	3	13
Chironomidae	13.77	8	42



FUNCTIONAL COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Predator	3.93	7	12
Parasite	3.61	1	11
Gatherer	57.38	16	175
Filterer	5.90	4	18
Herbivore	0.00	0	0
Piercer	0.00	0	0
Scraper	18.03	5	55
Shredder	11.15	3	34
Xylophage	0.00	0	0
Omnivore	0.00	0	0
Unknown	0.00	0	0



COMMUNITY TOLERANCES

Sediment tolerant taxa	2
Percent sediment tolerant	0.98
Sediment sensitive taxa	2
Percent sediment sensitive	0.98
Metals tolerance index (McGuire)	3.23
Cold stenotherm taxa	4
Percent cold stenotherms	2.62

DOMINANCE

TAXON	ABUNDANCE	PERCENT
Cinygmula sp.	49	16.07
Rhithrogena sp.	46	15.08
Baetis tricaudatus	33	10.82
Ephemerella sp.	32	10.49
Zapada cinctipes	27	8.85
SUBTOTAL 5 DOMINANTS	187	61.31
Ostracoda	14	4.59
Orthocladius sp.	14	4.59
Acari	11	3.61
Rheotanytarsus sp.	11	3.61
Pericoma sp.	10	3.28
TOTAL DOMINANTS	247	80.98

SAPROBITY

Hilsenhoff Biotic Index	2.49

DIVERSITY

Shannon H (loge)	2.44
Shannon H (log2)	3.52
Simpson D	0.08

VOLTINISM

TYPE	ABUNDANCE	PERCENT
Multivoltine	82	26.89
Univoltine	212	69.34
Semivoltine	12	3.77

TAXA CHARACTERS

	#TAXA	ABUNDANCE	PERCENT
Tolerant	3	35	11.48
Intolerant	5	13	4.26
Clinger	15	150	49.18

BIOASSESSMENT INDICES

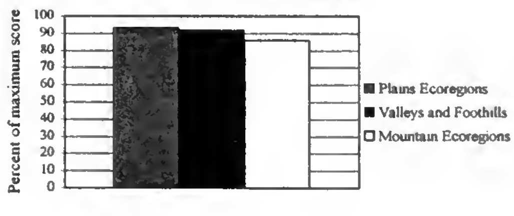
B-IBI (Karr et al.)

METRIC	VALUE	SCORE	
Taxa richness	36	3	
E richness	9	5	
P richness	4	3	
T richness	7	3	
Long-lived	4	3	
Sensitive richness	5	5	
%tolerant	11.48	5	
%predators	3.93	1	
Clinger richness	15	3	
%dominance (3)	41.97	5	
TOTAL SCORE		36	72 %

MONTANA DEQ METRICS (Bukantis 1998)

METRIC	VALUE	Plains Ecoregions	Valleys and Foothills	Mountain Ecoregions
Taxa richness	36	3	3	3
EPT richness	20	3	3	3
Biotic Index	2.49	3	3	3
%Dominant taxon	16.07	3	3	3
%Collectors	63.28	2	2	2
%EPT	70.16	3	3	3
Shannon Diversity	3.52	3		
%Scrapers +Shredd	29.18	2	2	1
Predator taxa	7	3		
%Multivoltine	26.89	3		
%H of T	9.6		3	
TOTAL SCORES		28	22	18
PERCENT OF MAXIMUM		93.33	91.67	85.71
IMPAIRMENT CLASS		NON	NON	NON

Montana DEQ metric batteries



Aquatic Invertebrate Taxonomic Data

Site Name: South Fork Judith River **Date: 8/30/01**

Site ID: Site 3: below confluence of Dry Pole Canyon Approx. percent of sample used: 10

Taxon	Quantity	Percent	HBI	FFG
Fossaria sp.	8	2.65	6	SC
Physella sp.	1	0.33	8	SC
Acari	81	26.82	5	PA
Total Misc. Taxa	**90**	**29.80**		
Baetis tricaudatus	6	1.99	4	CG
Diphetor hageni	8	2.65	5	CG
Procloeon sp.	1	0.33	4	CG
Drunella grandis	4	1.32	2	CG
Ephemerella sp.	2	0.66	1	CG
Cinygmula sp.	3	0.99	0	SC
Rhithrogena sp.	26	8.61	0	CG
Paraleptophlebia sp.	13	4.30	1	CG
Paraleptophlebia bicornuta	3	0.99	2	CG
Ameletus sp.	5	1.66	0	SC
Total Ephemeroptera	**71**	**23.51**		
Sweltsa sp.	8	2.65	0	PR
Zapada cinctipes	7	2.32	3	SH
Hesperoperla pacifica	1	0.33	2	PR
Isoperla sp.	1	0.33	2	PR
Total Plecoptera	**17**	**5.63**		
Arctopsyche grandis	6	1.99	2	PR
Brachycentrus sp.-early instar	5	1.66	1	CF
Micrasema sp.	2	0.66	1	SH
Glossosoma sp.	2	0.66	0	SC
Hydropsyche sp.	3	0.99	5	CF
Hydroptila sp.	7	2.32	6	PH
Lepidostoma sp.-sand case larvae	6	1.99	1	SH
Total Trichoptera	**31**	**10.26**		
Narpus sp.	1	0.33	2	CG
Optioservus sp.	57	18.87	5	SC
Zaitzevia sp.	4	1.32	5	CG
Total Coleoptera	**62**	**20.53**		
Bezzia/Palpomyia sp.	1	0.33	6	PR
Glutops sp.	1	0.33	1	PR
Antocha sp.	7	2.32	3	CG
Hexatoma sp.	1	0.33	2	PR
Total Diptera	**10**	**3.31**		
Cricotopus (Isocladius) Gr.	1	0.33	7	CG
Orthocladius sp.	2	0.66	6	CG
Pagastia sp.	8	2.65	1	CG
Potthastia sp.	2	0.66	2	CG
Rheotanytarsus sp.	1	0.33	6	CF
Thienemannimyia Gr.	5	1.66	5	PR
Tvetenia sp.	2	0.66	5	CG
Total Chironomidae	**21**	**6.95**		
Grand Total	**302**	**100.00**		

Aquatic Invertebrate Summary

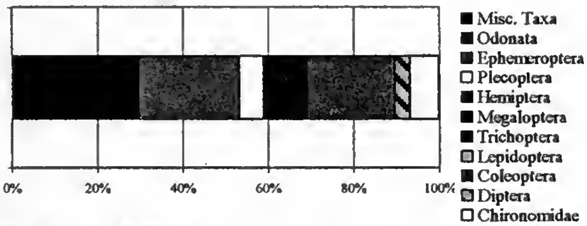
Site Name: South Fork Judith River **Date: 8/30/01**

Site ID: Site 3: below confluence of Dry Pole Canyon

SAMPLE TOTAL	302
EPT abundance	119
TAXA RICHNESS	38
Number EPT taxa	21
Percent EPT	39.40

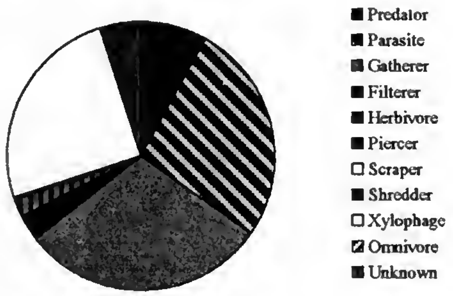
TAXONOMIC COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Misc. Taxa	29.80	3	90
Odonata	0.00	0	0
Ephemeroptera	23.51	10	71
Plecoptera	5.63	4	17
Hemiptera	0.00	0	0
Megaloptera	0.00	0	0
Trichoptera	10.26	7	31
Lepidoptera	0.00	0	0
Coleoptera	20.53	3	62
Diptera	3.31	4	10
Chironomidae	6.95	7	21



FUNCTIONAL COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Predator	7.95	8	24
Parasite	26.82	1	81
Gatherer	29.80	16	90
Filterer	2.98	3	9
Herbivore	0.00	0	0
Piercer	2.32	1	7
Scraper	25.17	6	76
Shredder	4.97	3	15
Xylophage	0.00	0	0
Omnivore	0.00	0	0
Unknown	0.00	0	0



COMMUNITY TOLERANCES

Sediment tolerant taxa	4
Percent sediment tolerant	5.63
Sediment sensitive taxa	2
Percent sediment sensitive	2.65
Metals tolerance index (McGuire)	3.92
Cold stenotherm taxa	1
Percent cold stenotherms	0.33

DOMINANCE

TAXON	ABUNDANCE	PERCENT
Acari	81	26.82
Optioservus sp.	57	18.87
Rhithrogena sp.	26	8.61
Paraleptophlebia sp.	13	4.30
Fossaria sp.	8	2.65
SUBTOTAL 5 DOMINANTS	185	61.26
Diphetor hageni	8	2.65
Sweltsa sp.	8	2.65
Pagastia sp.	8	2.65
Zapada cinctipes	7	2.32
Hydroptila sp.	7	2.32
TOTAL DOMINANTS	223	73.84

SAPROBITY

Hilsenhoff Biotic Index	3.56

DIVERSITY

Shannon H (loge)	2.38
Shannon H (log2)	3.43
Simpson D	0.11

VOLTINISM

TYPE	ABUNDANCE	PERCENT
Multivoltine	114	37.75
Univoltine	114	37.75
Semivoltine	74	24.50

TAXA CHARACTERS

	#TAXA	ABUNDANCE	PERCENT
Tolerant	7	86	28.48
Intolerant	1	1	0.33
Clinger	15	130	43.05

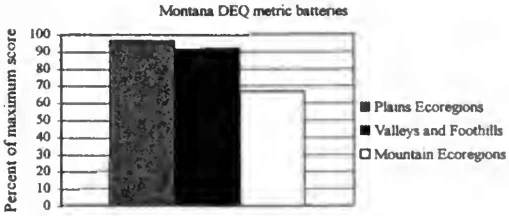
BIOASSESSMENT INDICES

B-IBI (Karr et al.)

METRIC	VALUE	SCORE	
Taxa richness	38	3	
E richness	10	5	
P richness	4	3	
T richness	7	3	
Long-lived	6	5	
Sensitive richness	1	1	
%tolerant	28.48	3	
%predators	7.95	1	
Clinger richness	15	3	
%dominance (3)	54.30	3	
TOTAL SCORE		30	60 %

MONTANA DEQ METRICS (Bukantis 1998)

METRIC	VALUE	Plains Ecoregions	Valleys and Foothills	Mountain Ecoregions
Taxa richness	38	3	3	3
EPT richness	21	3	3	3
Biotic Index	3.56	3	3	2
%Dominant taxon	26.82	3	3	2
%Collectors	32.78	3	3	3
%EPT	39.40	2	1	0
Shannon Diversity	3.43	3		
%Scrapers +Shredd	30.13	3	3	1
Predator taxa	8	3		
%Multivoltine	37.75	3		
%H of T	9.6		3	
TOTAL SCORES		29	22	14
PERCENT OF MAXIMUM		96.67	91.67	66.67
IMPAIRMENT CLASS		NON	NON	SLIGHT



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